



CROP DIVERSIFICATION FOR SUSTAINABLE AGRICULTURE

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Introduction

Agriculture is still the dominant sector of Indian economy because of its high share in employment and livelihood creation. Indian economy achieved a spectacular growth during post green revolution period due to the development of the improved production and protection technologies, but unabated growth in population and its excessive dependence on agriculture has posed serious challenge to policy makers and agricultural scientists. So India needs a major change in the working of agricultural sector and other related sectors.

The term 'diversification' has been derived from the word 'diverge' which means to move or extend in the direction different from a common point (Jha,1996). Agricultural diversification can be described in terms of the shift from the regional dominance of one crop towards the production of a large number of crops to meet the increasing demand of those crops. It can also be described as the economic development of non-agricultural activities (Minot, *et al.*, 2006).

Crop diversification or crop shift is a new paradigm of sustainable agriculture. Crop diversification is a demand driven, need based situation specific and national goal seeking continuous and dynamic concept and involves spatial, temporal, value addition and resource complementary approaches. Crop diversification can be a shift from a crop or cropping system to another crop or cropping system or use of resources in best possible way by changing and modifying the degree, trend and time options of crop/cropping activities or a shift from less profitable and sustainable crop or cropping system to more profitable and sustainable crop/cropping system. Crop diversification means to increase the total productivity in terms of quality, quantity and monetary value under specific, diverse agro-climatic situations worldwide. Opportunities for crop diversification vary depending on risks, opportunities and the feasibility of proposed changes within a socio economic context.

Various approaches of Crop Diversification

(A) **Horizontal diversification:** Through expanding the crop base by substituting or adding more crops into the cropping systems is known as horizontal diversification. It is of two types. (a) **Crop intensification:** Addition of more crops to the existing cropping system as a way to improve the overall productivity of a farm or region's farming economy. Eg. Intercropping, mixed cropping, sequential cropping, multi tier cropping (b) **Crop substitution:** Substituting less suitable crops with more suitable alternate crops depending on the agro climatic conditions of the area. Shifting high risk crops with short duration pulses and drought resistant oilseeds crops.

(B) Vertical diversification: Farmers and others add value to products through processing, regional branding, packaging, merchandising, or other efforts to enhance the product.

(C) Land based approach

- The selection of crops should be problem based e.g. on sloppy lands which are prone to soil erosion, an alternate cropping of erosion promoting and erosion resisting crops like legumes, should be adopted.
- Fertile and well-drained land should be utilized for important good rotation, less fertile land for soil improving crops (legumes) and salt tolerant crops on acidic, saline or alkali soils.

a) Crop diversification under arable lands

Conventional crops sometimes fail to provide stability of production over a period of time due to weather aberrations. Alternate land use systems are the means of stabilizing the productivity of such lands

1) Alley cropping: It is an agroforestry system in which food crops are grown in alleys formed by trees. Such agroforestry systems provide food grains, fodder, mulch, fuel wood etc.

2) Ley farming: It is growing of grass or legumes in rotation with grain crops. Grasses improve soil structure while the legumes enrich soil nitrogen status.

3) Agri-horticulture system: It is the form of agroforestry system having fruit trees as the tree component. Annual crops can be intercropped in these fruit plantations.

b) Crop diversification under marginal lands: Marginal lands are permanently disadvantaged in terms of steep slopes, poor drainage, poor soil depth and harsh environments. Such lands can be developed into pastures or can put to use for tree farming.

1) Pasture management: Different grasses such as *Cenchrus sp.*, *Chloris sp.*, *Panicum sp.* can be grown in mixture with perennial pasture legumes.

2) Silvi pastoral management: These systems have been found dependable for utilization of degraded lands because trees can tolerate extreme soil and climatic conditions whereas grasses and legumes provide good land cover.

(D) Water based approach: Diversion of high water requiring crops to less water intensive crops. In case of rain fed farming (assured rainfall) on moisture retentive soils after harvest of *Kharif* crop some minor crop requiring less moisture like pulses or cereals may be grown. Eg. Rice (*Kharif*) – Gram (*Rabi*)

a) Crop diversification under assured irrigation situations: Multiple cropping has the real potential in areas of assured soil moisture availability throughout the year. An assured moisture supply provides powerful inducements for sequential cropping. As per availability of irrigation water, two or three crops are taken in a year on same land under irrigated conditions. However a dry crop should be included in the rotation to avoid damage to the soil due to continuous irrigation.

b) Crop diversification under water scarce conditions (dryland areas): The cropping intensity varies with the amount of annual rainfall received as follows:

- 500-625 mm with less than 100 mm storage capacity-single monsoon cropping
- 625-750 mm-intercropping with crops of different maturity periods
- 750-900 mm with a soil storage capacity of about 150 mm- Relay cropping
- 900 mm with storage capacity of more than 200 mm-Double cropping

There can be situations where moisture may be enough to produce one crop but not enough to produce two. In this situation, intercropping systems can often provide the means of at least increasing the cropping intensity over that of a single crop.

(E) Varietal diversification: Low yielding varieties can be substituted with high yielding varieties to maximize profit.

(F) Crop diversification for nutrient management: The crops with taproot should be followed by those, which have a fibrous root system. This helps in proper and uniform use of nutrients from the soil and root do not compete with each other for uptake of nutrients. The leguminous crops should be grown after non-leguminous crops because leguminous fix atmospheric “N” into soil and add more organic matter to soil. A shallow rooted grain crop, deep rooted cash crop and restorative crop (legume crop) should be included in the rotation for providing food, fodder, cash and maintaining the fertility and productivity of soil. More exhaustive crops should be followed by less exhaustive crops because crops like potato, sugarcane, maize, etc. need more inputs such as better tillage, more fertilizer higher number of irrigations, more insecticides, better care than crops like oil seeds, pulses, etc. which need little less care or little less inputs.

(G) Crop diversification for risk reduction: Selection of the crops should be based on soil, climate, season and market demand. Selection of crops should be demand based, i.e. the crops, which are needed by the people or area so that produce can be sold at a higher price. The area devoted to each crop should be constant from year to year. The ideal crop rotation should be built up around a hub crop for which the greatest comparative advantages exist. E.g. In areas of dairy industry, oil seeds like groundnut or pulses will supply cattle feed (oil cakes and roughages) or in irrigated areas near cities, growing of vegetables or floriculture will be profitable.

Advantages of crop diversification

1. Inclusion of crops of different feeding zone and nutrient requirement could maintain the better balance of nutrient in soil. Growing crops of different root depths avoids continuous depletion of nutrients from same depth.
2. Crops requiring high irrigation when followed by crops requiring light irrigation, the overall water use efficiency and water productivity of the system is increased.
3. It improves soil structure, percolation and reduces chances of creation of hard-pan in sub soil and also reduces soil erosion.
4. There is an overall increase in yield of crops mainly due to maintenance of physical, chemical properties of soil. Soil fertility is restored by maintaining more organic matter, encouraging microbial activity and biological cycles and protecting the soil from erosion, salinity and acidity.
5. It helps in controlling insects, pests and soil borne diseases. It also controls weeds.
6. Diversification of crops reduces risk of financial loss due to unfavorable conditions.
7. The family needs of feed, food, fuel, fiber, etc. are fulfilled.
8. It facilitates even distribution of labour.
8. Farmers get a better price for his produce due to higher demand in local market. So there is regular flow of income over year.

Conclusion

Diversification in agriculture will have a tremendous impact on the agro-socio-economic areas and also in the uplifting of resource-inadequate farming communities. It will be able to generate income and employment opportunities for rural youth around the year for the utmost benefits of the Indian farmers. There are still numerous opportunities for crop diversification present and location specific approaches and full packages need to be prepared.

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